https://doi.org/10.48047/AFJBS.7.4.2025.844-856

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Effect of hull on germination of *Anacardium occidentale* L. seeds (Maroua, Far North, Cameroon)

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Volume: 7, Issue 4, Apr 2025

Received: 15 Feb 2025

Accepted: 05 Mar 2025

Published: 05 Apr 2025

doi:10.48047/AFJBS.7.4.2025.844-856

Abstract

Controlling germination parameters is a key factor in agriculture, since productivity can be increased depending on the choices made. The main objective of this study was to evaluate the impact of the shell on germination (germination rate, germination speed and germination time) and the growth parameters of *Anacardium occidentale* in order to optimize its germination and growth in the nursery. A total of 270 cashew nuts were sown for this experiment, including 90 shelled cashew nuts, 90 scarified nuts and 90 nuts for the control batch that had not undergone any pre-treatment in a randomized complete block design. The study showed that the germination rate varied significantly according to the treatments, with the best results for shelled seeds (77.8±.10,25%). The latency period also varied and was shorter for hulled seeds (6 days). Ten days after sowing, hulled seeds had better growth parameters than the other treatments, with 24.39±0.76cm for plant height, 6.43±0.04cm for collar diameter and 13.11±1.07 for number of leaves. These results are useful for the development of germination strategies for this species of socio-economic interest.

Keywords: *Anacardium occidentale*, hull, germination, growth parameters

I- Introduction

The current challenges faced by a number of African countries remain the fight for food self-sufficiency and poverty reduction. Cameroon is not exempted since agricultural production has not yet kept pace with the demographic explosion. Food insecurity affects around 25% of Cameroon's population, with disparities between regions and population groups (IRAD, 2008).

The production of *Anacardium occidentale* nuts is a promising economic activity for many tropical countries (De Figueiredo et al., 2001). The nut is the main commercial product and is

use in a wide range of domains, such as food processing, cosmetics, medicine and the automobile industry (Aliyu, 2007; Martinez et al., 2011).

Anacardium occidentale L. belongs to the Anacardiaceae family. It can grow up to around ten meters in height, with a trunk diameter of between 1.2 and 1.5 m (Lautié et al. 2001). Although it is hardy, it grows best at altitudes below 1,000m, in hot tropical areas with alternating dry and wet seasons. It adapts to a various type of soils, but prefers light, sandy, deep and well-drained soils with a clay content of 25%. Since 2015, Côte d'Ivoire has become the world's leading cashew nut producer and exporter with more than 700 thousand tons, overtaking India, Vietnam and Brazil (Kouassi, 2018). In Cameroon, although the crop was popularized in 1975, its production has long stagnated due to a lack of interest among the population (Efua et al., 2022). Cameroon is not cited among the best cashew nuts producers in Africa, even though it has enormous production potential (Invest in Cameroon, 2020). *Anacardium occidentale* only grows in the three northern regions of the country, namely Adamawa, the North and the Far North. Currently, following growing demand, its cultivation is spreading to other regions such as the East and Centre of the country (Hamawa et al., 2019).

This species with high socio-economic potential reproduces both sexually and asexually (Anjusha et al., 2015; Beyo et al., 2023). Several studies have evaluated the germination capacity of this Anacardiaceae, including Siriki et al's publication (2021) on the effect of seed origin on germination and growth parameters of *Anacardium occidentale* in nurseries in Mali, and that of Hamawa et al. (2019) on the effect of nut weight and fertilizer dose on the germination and growth of cashew in the Guinean savannah of Cameroon; those of Mamoudou et al. (2018) on the morphometric traits and germination of *Anacardium occidentale* nuts in Senegal; those of Anjusha et al. (2015) on the effect of fine weight on the germination of this species in India. Gibbon et al (1981) reported that many trees are found growing wild and that the plant germinates poorly, those that are cultivated are propagated by seeds which are planted at a rate of 2-3 per hole due to poor germination rates. However, as far as the effect of the hull on the germination of seeds of this species under the conditions of the sahelian zone of Cameroon is concerned, there are no studies.

The main objective of this work is to evaluate the impact of the hull on the germination of *Anacardium occidentale* in order to reduce the germination delay of the species

II- Materials and methods

1- Presentation of the study area

This study was conducted in the Far North region of Cameroon. The nursery work was carried out in Maroua, in Djarengol precisely in the *Ecole Française les Boukarous.* The site is richly planted with trees and therefore has a microclimate favourable to the installation of experimental plants propagation equipment. There is a lot of shade.

The Far North region covers an area of approximately 3,460 km^2, with Maroua as its regional capital. This region is located at an altitude of 500m between the 10th and 13th degrees of North latitude and between the 12th and 15th degrees of East longitude (Bayé- Niwa et al., 2015). There is a single rainy season with a maximum rainfall in August and average annual rates varying from 400 to 1100mm. The dry season is longer (seven months) and the climate is hotter when one moves away from the Mandaras Mountains (L'Hôte, 2000). The average annual temperature is 28°C (Wanguili et al., 2021). The vegetation is woody and herbaceous characteristic of the sudano-sahelian type, with the presence of *Anogeissus leiocarpa* on loose soil and *Boswelia dalzielii* on rocky soil (Fotsing, 20

2- Nut harvesting and nursery preparation

The nuts were harvested at the end of February directly in farms from the fallen fruits of the trees with the best phenotypic apple and nut characteristics. They were dried for 3 days under the sun and then stored in a bag.

The germination substrate (Figure1) was a mixture of black soil and sand in the proportions 2/3 and 1/3. The black soil was enriched with manure, watered and turned over for three weeks. Furadan was added to the prepared substrate to combat termites, certain insects and nematodes. It was then placed in pots measuring 12cm in diameter and 25cm high.

The seeds were sown in mid-July.

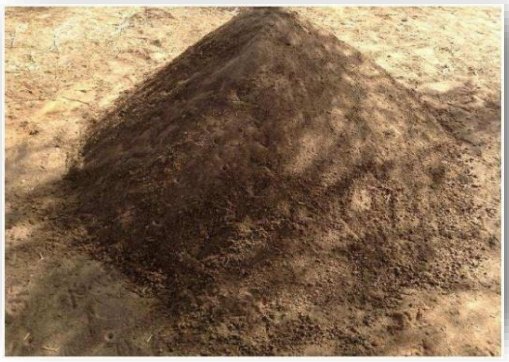


Figure1: Substrate preparation

3- Methodology

The methodology is based on that of Djaha et al (2010). The collected nuts were pre- treated before being placed in pots. They were first sorted visually. The nuts with the best morphological aspects (shape, filling and maturity) were sorted. The flotation test was then carried out in order to retain only viable seeds. This technic consists of soaking the nuts in tap water for 24 hours, then separating the floating nuts from those that would sink (good seeds).

Three pre-treatments are applied: the control, manual scarification and shelling.

Batch No.1 (The control) batch was soaked for 48 hours in tap water. This water was replaced every 6 hours to prevent the caustic acid in the shell from damaging the seed.

Batch No. 2 (which is made of scarified nuts) was also soaked in tap water for 48 hours under the same conditions as the control batch, then the seeds were scarified. Scarification consisted in delicately making a slit in the shell by using a sharp knife in order to facilitate the passage of water to the seed for faster germination (Figure 2a).

Batch No. 3 consists of hulled seeds (Figure 2b). These seeds were also soaked beforehand for 48 hours. Hulling consisted of making a slit whit a small sharp Knife in the softened hull after soaking and then gently separating the hull from the almond with hands. Wearing protective gloves and goggles is highly recommended, as the caustic acid contained in the hull is very aggressive if it comes into contact with the skin or eyes.

The pre-treated seeds are placed in pots at a shallow depth (around 5cm) and watered regularly when the humidity level in the pots drops. As the experiment was implanted in mid- July, the seeds were only watered on days when there was no rain. A nut germinates when the radicle pierces the envelopes and remains visible above the substrate (Mamoudou et al., 2018).

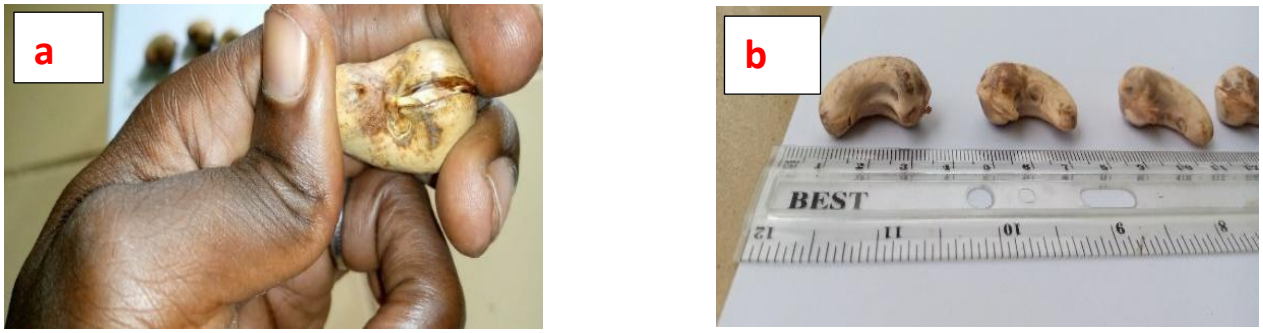


Figure 2: Pre-treatments applied
a- Scarified seeds, b- Deshelled seeds

The experimental design was a complete randomised block with thirty (30) pots as the experimental unit. Three treatments were applied, namely a control treatment, a batch that was scarified and a final batch that was dehulled. Each of the three treatments consisted of 3 replicates. That is 35x 3x3, with a total of 315 nuts sown in pots. This set-up enabled us to progressively assess the effect of the disappearance of the cashew shell on germination and certain growth parameters.

The experimental design is shown in the figure below.

Figure 3: experimental design

4. Data collection and analysis

The data collected concerned the germination rate and speed as well as growth parameters, specifically: diameter at the collar, seedling height and number of leaves.

Collar diameter was measured using a KS TOLLS electronic caliper with an accuracy of +/- 0.03 mm. Seedling height were measured using a graduated ruler, from the collar to the terminal bud (Figure 4). Leaves were counted by simple visual counting.

Figure 4: Measurement of growth parameters

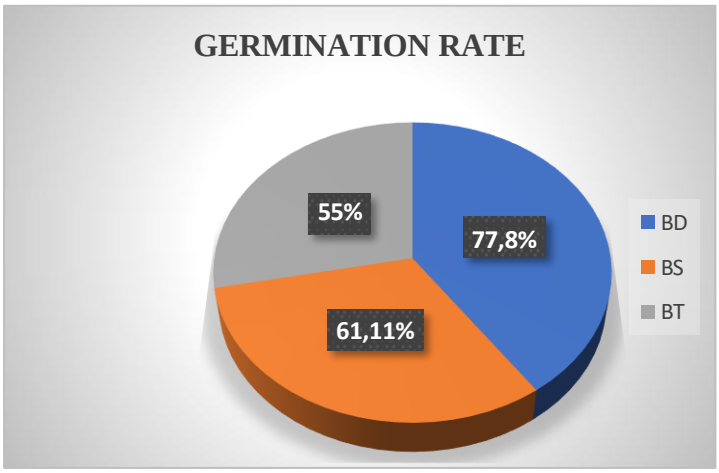
The data's collected were analyzed for variance and means comparison using Statgraphics 5.0 software. Means with significant differences were separated using Duncan's test. Graphs were produced using Microsoft Office 2016 Excel.

III- Results and discussion

III.1- Germination rate

Considered to be the first indicator of the success of a crop, it was determined from day 6, the date of the first emergence of shelled nuts, to day 18.

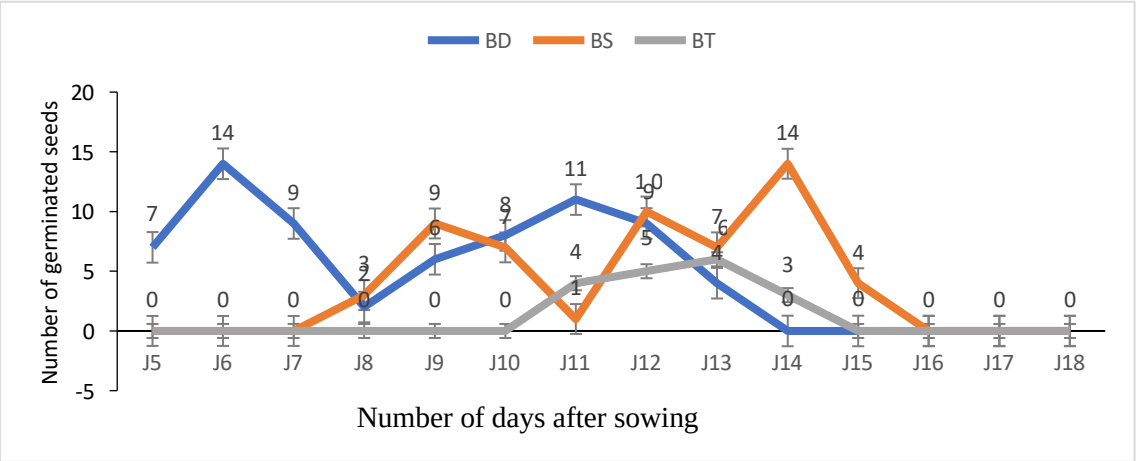
At day 18, the germination rate ranged from 55±.12, 1% for the control seeds to 77.8±.10,25% for the shelled nuts. Analysis of variance showed a significant difference (0.0265< 0.05) between the different treatments. These results showed that shelling clearly improves the germination rate of *Anacardium occidentale*. Compared to scarification and soaking for 48 hours in tap water. Furthermore, Djaha et al (2010) in their comparative germination studies between the LAX2081 variety and the LAX1432 variety of *Anacardium occidentale* noted an emergence rate of 37.50% for the LAX2081 variety and 40.83% for the LAX1432 variety. Siriki et al. (2021) tested the germination capacity of 4 varieties (V1, V2, V3, V4) on the same species in Mali. Variety 3 was the best with a very high germination rate (89%). Hamawa et al. (2019) in the high Guinean savannahs of Cameroon assessed the effect of fine mass on cashew germination. They found that the greater the mass is, the greater is the germination. Results contradicting those of Hamawa et al. (2019) were obtained by Anjusha et al. (2015). In fact, the various studies carried out on this Anacardiaceae show that germination is variable depending on the origin of the seeds, the varieties and the weight of the seeds.



BD= Hulled block, BS=Scarified block, BT=Control block

Figure 5: Germination rate by treatment

Figure 6 shows that the maximum number of germinated seeds was obtained on day 6 for hulled seeds (14 seeds), day 14 for scarified seeds (14 seeds) and day 13 for the control (4 seeds). Siriki et al. (2021) in Mali testing the germination of four provenances of the same species showed that seed emergence is staggered according to provenance. These authors stated that almost all the seeds germinated in the first two weeks, but germination was more intense in the first week than in the second.



BD= Hulled block, BS=Scarified block, BT=Control block

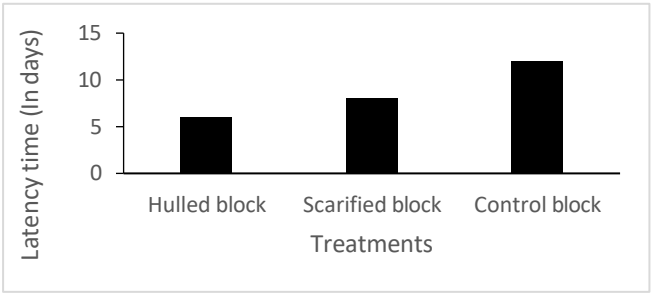
Figure 6: Number of germinated seeds per day per treatment

III.2- waiting time before germination and duration of germination

III.2.1- waiting time before germination

This is the time taken by the seed between sowing and germination. In our experiment, this time varied significantly (P<0.03) according to the pre-treatment applied. It was shorter (06 days) for hulled seeds, while scarified seeds began to germinate from the ninth day. The control seeds, which did not undergo any pre-treatment, took longer to germinate (12 days) (Figure 7). Dachung et al. (2023) obtained different results for *Detarium microcarpum* seeds treated with sulfuric acid, in which the first germinations appeared on the 14th day after sowing. The difference observed between these two species can be explained by intrinsic genetic factors specific to each of them. Madou et al. (2020) for their studies on the same species stated that the shortest latency period is obtained with scarification and this period is ten days. These results also differ from ours. This difference can be explained by the use of

different scarification methods. Mamoudou et al. (2017) on the same species state that the best performance is obtained with the combination of soaking for 48 hours and semi-vertical sowing. The results are better with scarification and hulling. Hamawa et al. (2019) in their studies on the effect of the weight and dose of fertilizer on the germination and growth of this Anacardiaceae obtained the first germinations at the third week in the Sudano-Guinean savannahs. These authors showed that nut mass influences germination and growth parameters. This study revealed that seed latency period varied according to pre-treatment. In our case, shelled seeds germinated faster than scarified and control seeds.



. **Figure 7**: Latency time

III.2.2- Germination delay

The hulled seeds germination lasted 9 days. After this period, the ungerminated seeds melted. Control seeds germinated for 8 days and hulled seeds for 10 days. For this parameter, there was no significant difference between the different pre-treatments (P = 0.057) and anyway after a certain period in the pot, the seeds melted. Thiocone et al. (2024) obtained longer germination times with seeds soaked for 48 hours. These times ranged from 15 to 17 days depending on the origin of the nuts.

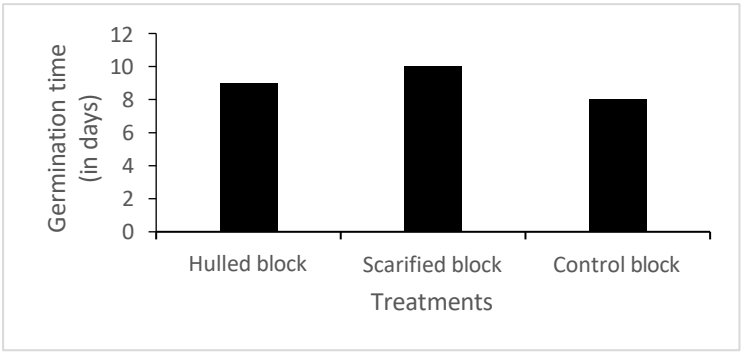


Figure 8: Germination delay according to treatments

III.2.2- Germination kinetics

The speed of germination varied according to the pre-treatment. The nut emergence rate (NER) is the time after which 50% of the nuts have germinated (Come, 1970; Scott et al., 1984). It is 11 days after sowing for shelled seeds and 14 days for scarified seeds. Germination speed is greater for hulled seeds, in which the first germinations were observed from the 6th day. The first germinations in scarified seeds appeared from the 9th day (Figure 8). These results differ from those obtained by Thiocone et al. (2024). These authors recorded slightly more than 50% of germinated seeds from day 21. The difference observed can be explained by the scarification method used, which in our case offers a larger contact surface between the kernel and water. In shelled nuts, the entire surface of the nut is in contact with the water, allowing faster absorption and therefore faster activation of the germination process.

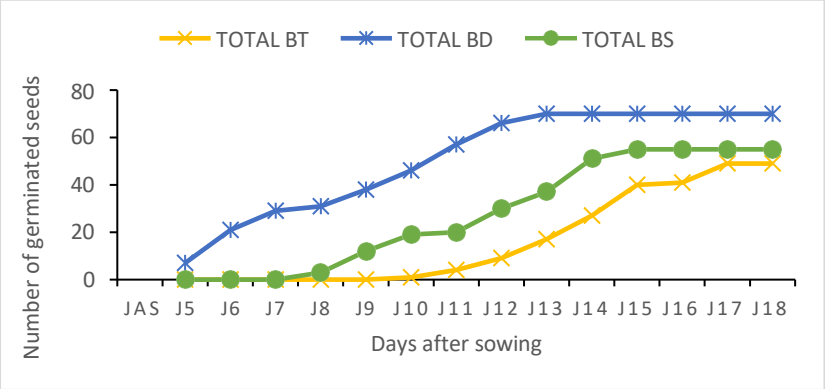


Figure 9: Seed emergence speed as a function of time treatment

III.2.3- Growth parameters

At week 10, plant height ranged from 19.1±1.76 cm in the control seeds to 24.39±0.76 cm in the hulled seeds (Table1). There was a significant difference between the hulled seeds and the other treatments. Issa et al. (2022) showed that the treatments had a negative effect on the height growth of *Detarium microcarpum*, with the highest average height growth obtained with the control batch. They showed that this parameter varies according to species and pre- treatment.

In terms of diameter at collar, hulled seeds have a larger neck diameter (6.43±0.04cm) than scarified seeds (6.3±0.25cm) and control seeds (5.72±0.18cm). Hulled and scarified seeds formed the same group. Analysis of variance indicates a significant difference between treatments (0.0075<0.05). Diameter at collar provides information on seedling vigor. This

parameter is strongly influenced by pre-treatment (El mostafa et al., 2013; Lahamedi et al., 2010). Arfang et al. (2018) show that collar diameter varies according to the substrate.

The number of leaves varied significantly (0.0243<0.05) according to treatment. It ranged from 10.66±0.66 in control seeds to 13.11±1.07 in deshelled seeds. Arfang et al (2018) corroborate these results and also show that mycohrization improves this parameter in the nursery. In addition, Boyombé et al (2021) in the Democratic Republic of Congo showed that this parameter is strongly linked to genetic factors and that it is much slower in some species.

Table 1: Growth parameters according to treatments

Treatments	**BD**	**BS**	**BT**
Height of plants (cm)	24.39±0.76b	20.63±1.23a	19.1±1.76a
Diameter at collar (cm)	6.43± 0.04b	6.3±0.25b	5.72±0.18a
Number of leaves	13.11±1.07b	12.11±0.51ab	10.66±0.66a

The averages of the same line followed by different letters are statistically different at the 5% threshold.

Conclusion

The aim of this study was to evaluate the impact of the hull on the germination of *Anacardium occidentale* in nursery under the ecological conditions of the soudano-sahelian zone. The results of this experiment showed an improvement of germination parameters and certain growth parameters. Deshelling considerably reduces the waiting time of germination. It increases the germination rate and germination kinetics. Plants grown from hulled seeds at the end of the experiment were taller and had more leaves than the other treatments. For further studies, it would be important to evaluate the effect of organic and biological amendments on the germination of this Anacardiaceae in this locality.

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